



Fish biologist Les Torrns (left) and catfish farmer Sam Pilkinton adjust the flow of liquid oxygen from the Sock Saver into the sock (in pond). Oxygen is added when dissolved oxygen in the pond is low.

Liquid Oxygen Saves Channel Catfish During Harvest

An improved method of supplying farm-raised catfish with enough oxygen during a crucial stage of production means more fish could survive to make it to market.

Les Torrns, an ARS fishery biologist in Stoneville, Mississippi, and his cooperators Charles D. Hogue, Jr., an aquaculture specialist with the Mississippi State University Extension Service, and Sam Pilkinton, a catfish farmer and live hauler with Pilkinton Brothers Farms in Columbus, Mississippi, designed and built equipment to apply liquid oxygen when fish are crowded together during harvest.

Channel catfish are harvested on commercial farms in the United States with long nets pulled by tractor and hydraulic net reels. This method has been used since the 1960s. In the final stages of harvest, fish are concentrated in net “socks” at high densities. They’re often held overnight to allow smaller, submarketable fish to escape, or “grade out,” through the mesh

of the sock. More than 50,000 pounds of food-size catfish can be held in a sock, which measures 10 feet wide and 50 to 100 feet long. To provide oxygen, water is slowly moved through the sock with tractor-powered or electric paddlewheel aerators.

When the dissolved oxygen level is high, sock-grading works well. But when it is low (as low as 0.5 milligrams per liter in some intensively managed production ponds), many fish can die. This is especially true in the summer when water temperatures are high.

Paddlewheel aerators are used to increase dissolved oxygen slightly while catfish are held in the sock. But the increased water velocity through the sock adds to the metabolic oxygen demand of the fish. After a night of chronic oxygen stress, fish are further crowded as they’re loaded onto a transport truck. This additional stress often results in several hundred pounds of dead fish arriving at the plant. The farmer gets no payment for these dead fish, called weigh-backs.

Torrans said he and others had been talking about using liquid oxygen in socks for about 15 years, but it hasn't been widely available until recently. Today, most private live haulers and fingerling producers use liquid oxygen on their transport trucks, and many farmers use it on their farm trucks when moving fish from pond to pond.

Air contains 21 percent oxygen and 78 percent nitrogen. When air is compressed and cooled, these gases become liquid. The liquid is warmed just enough for the nitrogen to turn back into a gas—leaving only liquid oxygen. It's commercially manufactured and delivered in tanker trucks to on-site storage vessels, much like gasoline is.

The availability of liquid oxygen spurred Torrans to write an article 2 years ago in an industry newspaper, in which he discussed the feasibility of using liquid oxygen in catfish production operations, especially during summer months.

Sam Pilkinton read the article and contacted Torrans. The two met, and together with Hogue, they designed and built the system they named the "Sock Saver."

Torrans says his 30 years of experience working with catfish on commercial farms, universities, and government agencies left him confident that the method would work. He says he knew catfish farmers like Pilkinton had the know-how to help design a successful system.

"Catfish farmers are out there every day doing research on their farms. They're constantly developing and adapting new ideas to fit their needs. They have the engineering experience to develop a hypothetical concept into a workable unit using available technology," Torrans says.

A small trailer was designed to hold three 50-gallon tanks to deliver the liquid oxygen wherever it's needed on the farm. It can be hauled behind a pickup truck or a small tractor around commercial ponds. The equipment is maintenance free, small, durable, and simple to operate, and it requires no power source. Individual flow regulators allow use of one to eight diffusers as they're needed. It is compatible with existing harvesting/loading equipment and methods, so farmers could use it without much training.

STEPHEN AUSMUS (K10601-1)



Workers prepare to haul another basket of catfish from the sock, where fish are first gathered and held overnight before being sent to market.

STEPHEN AUSMUS (K10598-1)



Paul Wilson, manager of Arrowhead Catfish Farm in Columbus, Mississippi, guides a basket containing 2,000 pounds of catfish into a transport truck that will haul the fish to a processing plant.

“There are no moving parts,” Hogue explains. “It’s completely self-contained and can be set up out of the way. It’s very easy to use.”

The unit can increase dissolved oxygen in the sock by as much as 0.9 milligrams per liter, enough to ensure survival of the fish. The total cost of the complete unit with trailer, tanks, pressure/flow regulators, and diffusers was \$8,400.

The Sock Saver costs less than \$3 an hour to operate. It has been tested on a commercial catfish farm for the past year, and initial reports are very positive.

Studies of oxygen transfer efficiencies are complete, and Torrans is analyzing the findings to determine exact measurement of dissolved oxygen in the socks. But people using the system are reporting livelier fish coming out of the socks.

“People in the field can see the results just by looking at the catfish,” Torrans says, “and they are saying that they have fewer weigh-backs.”

Torrans says that they are not making recommendations for

using liquid oxygen in production ponds at this time—other than in the socks. The mechanics of doing this are not worked out yet, but he predicts they soon will be. Torrans’s research shows that increasing dissolved oxygen in ponds results in faster-growing fish. “Oxygen is needed for metabolism and food digestion,” he says. “Low oxygen levels greatly reduce the amount of feed the fish eat. The more they eat, the sooner they make market size. They could reach market size in 2 years instead of 3, because with higher dissolved oxygen it takes them only a year, instead of 2, to go from fingerling to food fish.”—**By Jim Core, ARS.**

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Mississippi State extension agent Charles Hogue, Jr., takes an oxygen reading from one of the catfish ponds at Arrowhead Farm. In the background are paddlewheel aerators typically used to oxygenate the ponds.